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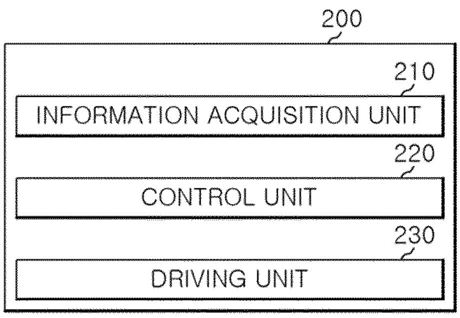
(54) **APPARATUS AND METHOD FOR DRIVING ELECTROCHROMIC DEVICE**

(57) There is provided an apparatus for driving an electrochromic device comprises: a memory; and a processor is configured to obtain operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of an electrochromic device operating so that transmittance for a specific wavelength is adjusted through color change when electricity is applied, to generate a control signal corresponding to a capacitance to be applied to the electrochromic device on a basis of the operating environment information, to apply the capacitance corresponding to the control signal to the electrochromic device to drive the electrochromic device so that the transmittance is adjusted, and to generate the control signal by reflecting climate characteristics obtained by analyzing the operating environment information.

FIG.2



Description

TECHNICAL FIELD

[0001] Embodiments relate to an apparatus and method for driving an electrochromic device that exhibits a light transmission variable function based on an electrochromic principle.

[0002] This work was supported by Korea Institute of Energy Technology Evaluation and Planning grant funded by the Korea government (Ministry of Trade, Industry and Energy) (Project unique No.: 1415181538; Project No.: 20192010107400; R&D project: Development of energy demand management core technology; Research Project Title: Development of energy self-sufficient smart window technology; and Project period: 2022.01.01. ~ 2022.09.30.).

BACKGROUND

[0003] With the recent increase in concerns for environmental protection, there has been a corresponding increase in interest in technologies that improve energy efficiency. For example, research and development on technologies such as a smart window and energy harvesting are being actively carried out.

[0004] The smart window refers to an active control technology that enhances energy efficiency by adjusting the transmittance of light from the outside, and can provide a comfortable environment to users. It is a foundation technology that can be commonly applied to various industries. The smart windows include an electrochromic device that undergoes an electrochemical oxidation or a reduction reaction with an applied power source, leading to changes in the intrinsic color of an electrochromic active material or an optical property, such as light transmittance.

[0005] When a film including this electrochromic device is applied to a window of an architectural structure, the amount of energy introduced into indoor areas may be adjusted by controlling the transmittance of a specific wavelength of solar rays through color change when electricity is applied.

[0006] The electrochromic device or film including the same according to the related art exhibited a nearly uniform characteristic of the chromic rate of the electrochromic device because a predetermined amount of electricity is supplied to the electrochromic device during the color change operation. There has been a problem where the uniform chromic rate of the electrochromic device has not satisfied diverse needs of consumer under various operating environments.

SUMMARY

[0007] According to an embodiment, there is provided an apparatus and method for driving an electrochromic device that is capable of allowing transmittance of the electrochromic device to be adjusted by varying capacitance applied to the electrochromic device according to solar altitude, azimuth angle, temperature, or the like that depends on an operating environment of the electrochromic device.

[0008] However, the problem to be solved by the present disclosure is not limited to that mentioned above, and other problems to be solved that are not mentioned may be clearly understood by those of ordinary skill in the art to which the present disclosure belongs from the following description.

[0009] There is provided an apparatus for driving an electrochromic device, according to a first aspect, the apparatus including information acquisition unit configured to obtain operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of the electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied, a control unit configured to generate a control signal corresponding to a capacitance to be applied to the electrochromic device on a basis of the operating environment information obtained by the information acquisition unit, and a driving unit configured to apply the capacitance corresponding to the control signal to the electrochromic device to drive the electrochromic device so that the transmittance is adjusted, and the control unit further configured to generate the control signal by reflecting climate characteristics obtained by analyzing the operating environment information.

[0010] There is provided a method of driving an electrochromic device, according to a second aspect, performed by an apparatus for driving an electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied, the method including obtaining operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of the electrochromic device, determining a capacitance to be applied to the electrochromic device on the basis of the obtained operating environment information, and applying the determined capacitance to the electrochromic device to drive the electrochromic device so that the transmittance is adjusted, and climate characteristics obtained by analyzing the operating environment information are reflected when the capacitance is determined.

[0011] There is provided a non-transitory computer-readable storage medium storing a computer program according to a third aspect, in which the computer program includes instructions for allowing a processor to perform the method of driving an electrochromic device.

[0012] According to an embodiment, there is an effect of creating a pleasant indoor environment in accordance with a changing operating environment by controlling the visible light transmittance and chromic rate by changing capacitance applied to an electrochromic device according to solar altitude, azimuth angle, temperature, or the like, which depends on an operating environment of the electrochromic device, so that the transmittance of the electrochromic device is adjusted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a block diagram of an apparatus for driving an electrochromic device, according to an embodiment of the present disclosure.
FIG. 2 is a block diagram conceptually illustrating a function of an electrochromic device driving program according to an embodiment of the present disclosure.
FIG. 3 is a configuration diagram of an information acquisition unit illustrated in FIG. 2, according to an embodiment of the present disclosure.
FIG. 4 is a structural view of an electrochromic device according to an embodiment of the present disclosure.
FIG. 5 is a structural view of an electrochromic device according to another embodiment of the present disclosure.
FIG. 6 is a flowchart for describing a method of driving an electrochromic device according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0014] The advantages and features of the embodiments and the methods of accomplishing the embodiments will be clearly understood from the following description taken in conjunction with the accompanying drawings. However, embodiments are not limited to those embodiments described, as embodiments may be implemented in various forms. It should be noted that the present embodiments are provided to make a full disclosure and also to allow those skilled in the art to know the full range of the embodiments. Therefore, the embodiments are to be defined only by the scope of the appended claims.

[0015] Terms used in the present specification will be briefly described, and the present disclosure will be described in detail.

[0016] In terms used in the present disclosure, general terms currently as widely used as possible while considering functions in the present disclosure are used. However, the terms may vary according to the intention or precedent of a technician working in the field, the emergence of new technologies, and the like. In addition, in certain cases, there are terms arbitrarily selected by the applicant, and in this case, the meaning of the terms will be described in detail in the description of the corresponding invention. Therefore, the terms used in the present disclosure should be defined based on the meaning of the terms and the overall contents of the present disclosure, not just the name of the terms.

[0017] Throughout the description of the present specification, in the case in which each film, window, panel, structure, layer, or the like is described as being formed "on" or "under" another film, window, panel, structure, layer, or the like, it means not only that one constituent element is "directly" formed on or under another constituent element, but also that one constituent element is "indirectly" formed on or under another constituent element with other element(s) interposed therebetween.

[0018] In addition, the reference for on or under with respect to each constituent element may be described with reference to the drawings. For the sake of description, the sizes of individual constituent elements in the appended drawings may be exaggeratingly depicted and do not indicate the actual sizes for the applications. In addition, like reference numerals indicate like constituent elements throughout the specification.

[0019] When it is described that a part in the overall specification "includes" a certain component, this means that other components may be further included instead of excluding other components unless specifically stated to the contrary.

[0020] Throughout the specification, unless otherwise specified, singular expressions are to be interpreted as including both the singular and plural forms as understood from the context.

[0021] In addition, all numbers and expression related to the quantities of components, reaction conditions, and the like used herein are to be understood in all cases as being modified by the term "about," unless otherwise indicated.

[0022] The terms first, second, and the like are used herein to describe various constituent elements, and the constituent elements should not be limited by the terms. The terms are used only for the purpose of distinguishing one constituent element from another.

[0023] In addition, a term such as a "unit" or a "portion" used in the specification means a software component or a hardware component such as FPGA or ASIC, and the "unit" or the "portion" performs a certain role. However, the "unit" or the "portion" is not limited to software or hardware. The "portion" or the "unit" may be configured to be in an addressable storage medium, or may be configured to reproduce one or more processors. Thus, as an example, the "unit" or the "portion" includes components (such as software components, object-oriented software components, class components, and task components), processes, functions, properties, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuits, data, database, data structures, tables, arrays, and variables. The functions provided in the components and "unit" may be combined into a smaller number of components and "units" or may be further divided into additional components and "units". Hereinafter, the embodiment of the present disclosure will be described in detail with reference to the accompanying drawings so that those of ordinary skill in the art may easily implement the present disclosure. In the drawings, portions not related to the description are omitted in order to clearly describe the present disclosure.

[0024] FIG. 1 is a block diagram illustrating an apparatus for driving an electrochromic device, according to an embodiment of the present disclosure.

[0025] With reference to FIG. 1, an apparatus 100 of driving an electrochromic device may include a processor 110, a transceiver 120, a memory 130, a measurement device 140, and a transmittance adjusting device 150.

[0026] The processor 110 may control an overall operation of the apparatus 100 for driving an electrochromic device.

[0027] The processor 110 may receive, using the transceiver 120, at least one of operating environment information including at least one of solar altitude, variable azimuth angle, and temperature, and installation environment information including at least one of fixed azimuth angle and latitude of an electrochromic device, according to an operating environment of the electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied.

[0028] In the present disclosure, it is described that at least one of operating environment information or installation environment information is received through the transceiver 120, but the present disclosure is not limited thereto. That is, according to an embodiment, the apparatus 100 for driving an electrochromic device may include an input/output device (not illustrated), the apparatus 100 for driving an electrochromic device may receive at least one of operating environment information or installation environment information using the input/output device (not illustrated), and at least one of operating environment information or installation environment information may be generated within the apparatus 100 for driving an electrochromic device.

[0029] The processor 110 may obtain operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of an electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied, generate a control signal corresponding to capacitance to be applied to the electrochromic device on the basis of the operating environment information, and apply the capacitance corresponding to the control signal to the electrochromic device to drive the electrochromic device so that the transmittance is adjusted, and the processor may reflect climate characteristics obtained by analyzing the operating environment information to generate the control signal.

[0030] The transceiver 120 may include a transmitter 121 and a receiver 122.

[0031] The memory 130 may store an electrochromic device driving program 200 and information required for execution of the electrochromic device driving program 200.

[0032] The measurement device 140 may include an altitude finder 141, an azimuth finder 142, and a thermometer 143, in which the altitude finder 141 may measure the altitude of the sun, the azimuth finder 142 may measure the variable azimuth angle or fixed azimuth angle of the electrochromic device, and the thermometer 143 may measure the temperature of the electrochromic device.

[0033] The transmittance adjusting device 150 may apply capacitance corresponding to the generated control signal to the electrochromic device so that transmittance of a window is adjusted.

[0034] In the present specification, the electrochromic device driving program 200 may mean software that includes instructions for receiving operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of an electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied, generating a control signal corresponding to capacitance to be applied to the electrochromic device, and applying the capacitance corresponding to the control signal to the electrochromic device to drive the electrochromic device so that transmittance is adjusted.

[0035] The processor 110 may load the electrochromic device driving program 200 and information required for execution of the electrochromic device driving program 200 from the memory 130 in order to execute the electrochromic device driving program 200.

[0036] The processor 110 may execute the electrochromic device driving program 200 to apply capacitance corresponding to the control signal to the electrochromic device, thereby allowing the transmittance for a specific wavelength of the electrochromic device to be adjusted.

[0037] The function and/or operation of the electrochromic device driving program 200 will be described in more detail with reference to FIG. 2.

[0038] FIG. 2 is a block diagram conceptually illustrating a function of an electrochromic device driving program according to an embodiment of the present disclosure.

[0039] With reference to FIG. 2, the electrochromic device driving program 200 may include an information acquisition unit 210, a control unit 220, and a driving unit 230.

[0040] The information acquisition unit 210, the control unit 220, and the driving unit 230 illustrated in FIG. 2 are conceptually divided for easily describing the function of the electrochromic device driving program 200, but the present disclosure is not limited thereto. According to embodiments, the functions of the information acquisition unit 210, the control unit 220, and the driving unit 230 may be mergeable/separable and may be implemented as a series of instructions included in one program. The functions of the information acquisition unit 210, the control unit 220, and the driving unit 230 included in the electrochromic device driving program 200 will be described below.

[0041] FIG. 3 is a configuration diagram of the apparatus for driving an electrochromic device illustrated in FIG. 1, according to an embodiment of the present disclosure.

[0042] According to an embodiment, as illustrated in the drawing, the apparatus 100 of driving an electrochromic device may include the measurement device 140, and may include, for example, the altitude finder 141, the azimuth finder 142, or the thermometer 143. When a film including an electrochromic device and the like is applied to a window, the altitude finder 141, the azimuth finder 142, and the thermometer 143 may be installed on an outer side of the window. Further, the transmitter 121 may be installed on an outer side of the window, and the receiver 122 may be installed on an inner side of the window.

[0043] The information acquisition unit 210 is configured to obtain operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of the electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied.

[0044] For example, the apparatus 100 of driving an electrochromic device may include the altitude finder 141, the information acquisition unit 210 may be provided with solar altitude measured through the altitude finder 141 using the transmitter 121 and the receiver 122, and obtain and provide the solar altitude as operating environment information to the control unit 220.

[0045] A film including an electrochromic device and the like may be applied to a window, and when the window including the electrochromic device is a fixture of a fixed-type architectural structure or the like, the electrochromic device may also be said to have fixed azimuth angle. However, when the window including the electrochromic device is a fixture of a movable-type architectural structure or the like, the electrochromic device may also be said to have variable azimuth angle. In addition, when the electrochromic device has variable azimuth angle, the information acquisition unit 210 may be provided with the variable azimuth angle measured through the azimuth finder 142 using the transmitter 121 and the receiver 122, and obtain and provide the variable azimuth angle as operating environment information to the control unit 220. In addition, when the electrochromic device has fixed azimuth angle, the information acquisition unit 210 may be provided with the fixed azimuth angle measured through the azimuth finder 142 using the transmitter 121 and the receiver 122, and obtain and provide the fixed azimuth angle as installation environment information to the control unit 220, and the fixed azimuth angle of the azimuth finder 142 may be set in the control unit 220 independent of the measurement of the azimuth finder 142. In addition, the information acquisition unit 210 may be provided with temperature measured through the thermometer 143 using the transmitter 121 and the receiver 122, and obtain and provide the temperature as operating environment information to the control unit 220.

[0046] The control unit 220 is configured to generate a control signal corresponding to capacitance to be applied to the electrochromic device on the basis of the operating environment information obtained by the information acquisition unit 210. Here, the control unit 220 reflects climate characteristics obtained by analyzing the operating environment information to generate a control signal. For example, the control unit 220 may generate a control signal so that visible light transmittance of the electrochromic device reaches a preset transmittance or less within a predetermined period of time according to an altitude comparison result of comparing the solar altitude provided by the information acquisition unit 210 to a preset threshold altitude. Here, the control unit 220 may generate a control signal further on the basis of installation environment information including at least one of fixed azimuth angle and latitude of the electrochromic device. Alternatively, the control unit 220 may generate a control signal according to an azimuth angle comparison result of comparing variable azimuth angle or fixed azimuth angle to a preset threshold azimuth angle and an altitude comparison result. For example, the control unit 220 may generate a control signal according to a difference between the latitude of the electrochromic device and the solar altitude. Alternatively, the control unit 220 may generate a control signal according to a difference between the latitude of the electrochromic device and the solar altitude and temperature. Alternatively, the control unit 220 may generate a control signal according to a latitude and altitude comparison result of the electrochromic device and temperature. Alternatively, the control unit 220 may generate a control signal according to an azimuth angle comparison result of comparing variable azimuth angle or fixed azimuth angle to a preset threshold azimuth angle, and according to a position of the electrochromic device, temperature, and date and time.

[0047] The driving unit 230 is configured to apply capacitance corresponding to a control signal of the control unit 220 to the electrochromic device to drive the electrochromic device so that transmittance for a specific wavelength is adjusted.

[0048] FIG. 4 is a structural view of an electrochromic device according to an embodiment of the present disclosure, and FIG. 5 is a structural view of an electrochromic device according to another embodiment of the present disclosure.

[0049] As illustrated in FIGS. 4 and 5, an electrochromic device 300 according to an embodiment may include a first base layer 310, a first barrier layer 320 on the first base layer 310, a light transmissive variable structure 330 on the first barrier layer 320, a second barrier layer 340 on the light transmissive variable structure 330, and a second base layer 350 on the second barrier layer 340. In addition, the electrochromic device 300 may further include a release film layer 360 on a surface opposite to a surface of the first base layer 310 on which the first barrier layer 320 is stacked. In addition, the electrochromic device 300 may further include a hard coating layer 370 on a surface opposite to a surface of the second base layer 350 on which the second barrier layer 340 is stacked.

[0050] The first base layer 310 and the second base layer 350 correspond to layers for maintaining transparency and durability, and may include a polymer resin. For example, the first base layer 310 and the second base layer 350 may each include at least one selected from the group consisting of a polyester-based resin, an acrylic-based resin, a polyolefin-based resin, and combinations thereof. For example, the first base layer 310 and the second base layer 350 may each include, but are not limited to, polyethylene terephthalate (PET), polyethylene naphthalate (PEN), or polycarbonate (PC). As another example, the first base layer 310 and the second base layer 350 may each include polyethylene terephthalate (PET). With the first base layer 310 and the second base layer 350 including the polymer resin described above, a flexible electrochromic device having both durability and flexibility may be implemented.

[0051] The first base layer 310 and the second base layer 350 may each have a light transmittance of 80 % or more for light with a wavelength of 550 nm. For example, the first base layer 310 and the second base layer 350 may have a light transmittance of 85 % or more or 90 % or more for light with a wavelength of 550 nm, respectively.

[0052] The first base layer 310 and the second base layer 350 may each have a haze of 2.0 % or less, 1.8 % or less, or 1.5 % or less.

[0053] The first base layer 310 and the second base layer 350 may each exhibit transparency by being satisfied with light transmittance and haze in the ranges described above.

[0054] The first barrier layer 320 and the second barrier layer 340 serve to prevent impurities, including moisture or gases, from infiltrating the light transmissive variable structure 330 from the outside.

[0055] The first barrier layer 320 may include two or more layers. For example, the first barrier layer 320 may include two layers, or may include three layers.

[0056] The second barrier layer 340 may include two or more layers. For example, the second barrier layer 340 may include two layers, or may include three layers.

[0057] The first barrier layer 320 may include at least one selected from the group consisting of metal oxides, metal nitrides, metal oxynitrides, metalloid oxides, metalloid nitrides, metalloid oxynitrides, and combinations thereof. For example, the first barrier layer 320 may include at least one selected from the group consisting of metal nitrides, metal oxynitrides, metalloid nitrides, metalloid oxynitrides, and combinations thereof. For example, the first barrier layer 320 may include a metal nitride or a metalloid nitride.

[0058] The second barrier layer 340 may include at least one selected from the group consisting of metal oxides, metal nitrides, metal oxynitrides, metalloid oxides, metalloid nitrides, metalloid oxynitrides, and combinations thereof. For example, the second barrier layer 340 may include at least one selected from the group consisting of metal nitrides, metal oxynitrides, metalloid nitrides, metalloid oxynitrides, and combinations thereof. For example, the second barrier layer 340 may include a metal nitride or a metalloid nitride.

[0059] The first barrier layer 320 and the second barrier layer 340 may be deposited on the first base layer 310 and the second base layer 350 by a vacuum deposition method, respectively. For example, the first barrier layer 320 and the second barrier layer 340 may be deposited on the first base layer 310 and the second base layer 350 by a sputtering deposition method, respectively. In this case, the deposition raw material may be one or more of a metal or a metalloid, and is not particularly limited in type, but may include, for example, at least one selected from magnesium (Mg), silicon (Si), indium (In), titanium (Ti), bismuth (Bi), germanium (Ge), and aluminum (Al). The deposition reaction gas may include oxygen (O_2) gas or nitrogen (N_2) gas. When oxygen gas is used as the reaction gas, a barrier layer including a metal oxide or a metalloid oxide may be formed, and when nitrogen gas is used as the reaction gas, a barrier layer including a metal nitride or a metalloid nitride may be formed. When oxygen gas and nitrogen gas are appropriately mixed and used as the reaction gas, a barrier layer including a metal oxynitride or a metalloid oxynitride may be formed.

[0060] The light transmissive variable structure 330 may include a first electrode layer 331, a first chromic layer 333 on the first electrode layer 331, an electrolyte layer 335 on the first chromic layer 333, a second chromic layer 337 on the electrolyte layer 335, and a second electrode layer 339 on the second chromic layer 337.

[0061] The light transmissive variable structure 330 may be a structure in which the first electrode layer 331, the first chromic layer 333, the electrolyte layer 335, the second chromic layer 337, and the second electrode layer 339 are sequentially stacked. For example, the light transmissive variable structure 330 may be a stacked structure whose light transmittance reversibly changes when a predetermined voltage is applied.

[0062] When a voltage is applied to the first electrode layer 331 and the second electrode layer 339, the overall light transmittance increases and then decreases due to specific ions or electrons that move through the electrolyte layer 335 from the second chromic layer 337 to the first chromic layer 333. When the light transmittance of the second chromic layer

337 decreases, the light transmittance of the first chromic layer 331 also decreases, and when the light transmittance of the second chromic layer 337 increases, the light transmittance of the first chromic layer 331 also increases.

[0063] The first electrode layer 331 and the second electrode layer 339 may each include a transparent electrode or a reflective electrode. For example, one of the first electrode layer 331 or the second electrode layer 339 may be a transparent electrode and the other may be a reflective electrode. Alternatively, both the first electrode layer 331 and the second electrode layer 339 may be transparent electrodes.

[0064] The first electrode layer 331 may be deposited and formed on the first barrier layer 320 by a sputtering method. In addition, the second electrode layer 339 may be deposited and formed on the second barrier layer 340 by a sputtering method.

[0065] The first chromic layer 333 is a layer whose light transmittance changes when a voltage is applied between the first electrode layer 331 and the second electrode layer 339, and is a layer that imparts variability in light transmittance to the electrochromic device 300.

[0066] The first chromic layer 333 includes at least one layer, and two or more layers of different materials may be applied, as necessary.

[0067] The first chromic layer 333 may include at least one selected from the group consisting of titanium oxide (TiO), vanadium oxide (V_2O_5), niobium oxide (Nb_2O_5), chromium oxide (Cr_2O_3), manganese oxide (MnO_2), iron oxide (FeO_2), cobalt oxide (CoO_2), nickel oxide (NiO_2), rhodium oxide (RhO_2), tantalum oxide (Ta_2O_5), iridium oxide (IrO_2), tungsten oxide (WO_3), viologen, and combinations thereof.

[0068] The first chromic layer 333 may be formed by depositing a raw material on one surface of the first electrode layer 331 by a sputtering method, or by applying a raw material by a wet coating method, followed by drying. For example, the first chromic layer 333 may be formed by applying a raw material to one surface of the first electrode layer 331 by a wet coating method, followed by drying.

[0069] The first electrode layer 331 and the first chromic layer 333 have an initial transmittance of 90 % or more. As such, an initial transmittance of 90 % or more exhibits that each layer has been applied very uniformly and is very transparent.

[0070] The electrolyte layer 330 is a layer that serves as an ion transport path between the first chromic layer 333 and the second chromic layer 337, and the type of electrolyte used in the electrolyte layer is not particularly limited. For example, the electrolyte layer 330 may include hydrogen ions or Group 1 element ions. For example, the electrolyte layer 330 may include a lithium salt compound. The lithium salt compound may be, but is not limited to, $LiClO_4$, $LiBF_4$, $LiAsF_6$, $LiPF_6$, LiTFSi, LiFSi, and the like. In addition, the electrolyte layer 330 may include a polymer resin. For example, the electrolyte layer 330 may include an acrylic-based resin, an epoxy-based resin, a silicone-based resin, a polyimide-based resin, or a polyurethane-based resin, but is not limited thereto. For example, the acrylic-based resin may be a thermosetting acrylic-based resin, a photocurable acrylic-based resin, or the like, and the polyurethane-based resin may be a thermosetting polyurethane-based resin, a photocurable polyurethane-based resin, an aqueous polyurethane-based resin, or the like.

[0071] The electrolyte layer 335 may be formed by applying a raw material to one surface of either the first chromic layer 333 or the second chromic layer 335 by a wet coating method, followed by drying. When the electrolyte layer 335 is applied by a wet coating method, the thickness of the coating film may be thickened or the thickness of the coating film may be easily controlled, which is advantageous in terms of enhancing ionic conductivity or chromic rate.

[0072] The thickness of the electrolyte layer 335 may be 30 μm to 200 μm, 50 μm to 200 μm, 50 μm to 150 μm, 70 μm to 130 μm, or 80 μm to 120 μm. When the thickness of the electrolyte layer 335 satisfies the above ranges, the ion transport path between the first chromic layer 333 and the second chromic layer 335 is secured at an appropriate length while the durability is imparted to the electrochromic device 300, thereby implementing the light transmission change performance at an appropriate rate.

[0073] The second chromic layer 337 is a layer whose light transmittance changes when a voltage is applied between the first electrode layer 331 and the second electrode layer 339, and is a layer that imparts variability in light transmittance to the electrochromic device.

[0074] The second chromic layer 337 includes at least one layer, and two or more layers of different materials may be applied, as necessary.

[0075] The second chromic layer 337 may include at least one selected from the group consisting of nickel oxide (e.g., NiO, NiO_2), manganese oxide (e.g., MnO_2), cobalt oxide (e.g., CoO_2), iridium-magnesium oxide, nickel-magnesium oxide, titanium-vanadium oxide, and combinations thereof. Alternatively, the second chromic layer 337 may include, but is not limited to, a Prussian blue-based pigment.

[0076] The second chromic layer 337 may be formed by depositing a raw material on one surface of the second electrode layer 339 by a sputtering method, or by applying a raw material by a wet coating method, followed by drying. For example, the second chromic layer 337 may be formed by applying a raw material to one surface of the second electrode layer 339 by a wet coating method, followed by drying.

[0077] The second chromic layer 337 may have an initial transmittance of 50 % or less. As such, an initial transmittance of 50 % or less may mean that the color appears dark blue or pale indigo when viewed with the naked eye.

[0078] The first chromic layer 333 may include a material having a chromogenic property complementary to the electrochromic material included in the second chromic layer 337. The complementary chromogenic property means that the types of reactions by which the electrochromic material develops color are different from each other. For example, when an oxidizing chromic material is used in the first chromic layer 333, a reducing chromic material may be used in the second chromic layer 337. Alternatively, when a reducing chromic material is used in the first chromic layer 333, an oxidizing chromic material may be used in the second chromic layer 337. An oxidizing chromic material refers to a material that changes color when an oxidation reaction takes place, and a reducing chromic material refers to a material that changes color when a reduction reaction takes place. That is, when an oxidation reaction takes place in a chromic layer to which an oxidizing chromic material is applied, a coloration reaction takes place, and when a reduction reaction takes place, a decoloration reaction takes place. When a reduction reaction takes place in a chromic layer to which a reducing chromic material is applied, a coloration reaction takes place, and when an oxidation reaction takes place, a decoloration reaction takes place. As such, a material having a complementary chromogenic property is included in each chromic layer, so that the coloration or decoloration may be carried out simultaneously in both layers. In addition, coloration or decoloration may be alternated according to the polarity of the voltage applied to the electrochromic device 300.

[0079] The release film layer 360 may include a polyester-based resin including polyethylene terephthalate (PET), polyethylene naphthalate (PEN), or polycarbonate (PC). The release film layer 360 serves to protect the electrochromic device 300 from external moisture or impurities when the electrochromic device 300 is stored and moved. When the electrochromic device 300 is later applied to a transparent window or the like, the electrochromic device 300 may be used after the release film layer 360 is removed, as necessary.

[0080] The hard coating layer 370 may include an acrylic-based resin, a silicone-based resin, a polyurethane-based resin, an epoxy-based resin, or a polyimide-based resin. For example, the hard coating layer 370 may have a pencil hardness of 3H or more, 4H or more, or 5H or more, but is not limited thereto. The hard coating layer 370 serves to protect the electrochromic device from external impacts, and may impart excellent hardness because of its resistance to scratches or the like.

[0081] The electrochromic device 300 may be applied through a way of simply attaching the electrochromic device to a structure such as a conventional transparent window. For example, the electrochromic device 300 may be attached to one surface of a window, and the window may have a flat surface or a curved surface. In addition, the electrochromic device 300 may be attached to the entire surface of the window, or only a portion of the window. Alternatively, the electrochromic device 300 may be inserted into the window. For example, the electrochromic device 300 may be applied through a way of interposing the electrochromic device 300 between glass substrates. For example, the electrochromic device 300 may be applied by interposing two polyvinyl butyral films (PVB films) between laminated glasses of a window, and interposing the electrochromic device 300 between the two PVB films, and may be stably inserted into the window by compression with heat.

[0082] The electrochromic device 300 may adjust the transmittance of infrared rays and ultraviolet rays as well as visible light upon coloration and decoloration. When power is applied to the electrochromic device 300, an electric field is formed between the first electrode layer 331 and the second electrode layer 339, causing coloration and decoloration, which may adjust the transmittance for each wavelength of solar rays. Therefore, it is useful to implement an insulation function and a sunshade function. In addition, the electrochromic device 300 may be manufactured with a large area at a low cost and has low power consumption. Therefore, it is suitable for use in a smart window, a smart mirror, and other next generation architectural window materials.

[0083] FIG. 6 is a flowchart for describing a method of driving the electrochromic device 300 according to an embodiment of the present disclosure.

[0084] Hereinafter, with reference to the accompanying drawings, a process in which transmittance for a specific wavelength is adjusted through color change of the electrochromic device 300 according to an embodiment of the present disclosure will be described.

[0085] First, the information acquisition unit 210 of the apparatus 100 of driving an electrochromic device is configured to obtain operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of the electrochromic device 300, and provides the obtained operating environment information to the control unit 220. Here, the altitude finder 141 may measure and provide solar altitude to the transmitter 121, the azimuth finder 142 may measure and provide variable azimuth angle of the electrochromic device 300 to the transmitter 121, and the thermometer 143 may measure and provide temperature to the transmitter 121. Then, the transmitter 121 may transmit the operating environment information measured by the altitude finder 141, the azimuth finder 142, and/or the thermometer 143, the receiver 122 may receive the operating environment information transmitted from the transmitter 121, and the information acquisition unit 210 may obtain and provide the operating environment information to the control unit 220 (S610).

[0086] The control unit 220 is configured to generate a control signal corresponding to capacitance to be applied to the electrochromic device 300 on the basis of the operating environment information obtained by the information acquisition unit 210. Here, the control unit 220 reflects climate characteristics obtained by analyzing the operating environment information to generate a control signal. For example, the control unit 220 may generate a control signal so that visible light transmittance of the electrochromic device 300 reaches a preset transmittance or less within a predetermined period of time according to an altitude comparison result of comparing the solar altitude provided by the information acquisition unit 210 to a preset threshold altitude (S630).

[0087] Then, the driving unit 230 of the apparatus 100 of driving an electrochromic device is configured to apply capacitance corresponding to the control signal of the control unit 220 to the electrochromic device 300 to drive the electrochromic device so that the transmittance for a specific wavelength is adjusted (S640).

[0088] The weather data observed in Busan in the year of 2000 is exemplified in Table 1.

[Table 1]

Date		Starting at 40 deg. or more (Time/Elevation angle)	Starting at 40 deg. or less (Time/Elevation angle)
Spring Equinox	3.20	10 o'clock, 40 deg.	15 o'clock, 40 deg.
Summer solstice	6.21	9 o'clock, 44 deg.	16 o'clock, 42 deg.
Autumnal equinox	9.23	10 o'clock, 32 deg.	15 o'clock, 37 deg.
Winter solstice	12.22	None (Max. 31 deg.)	

[0089] With reference to the weather data exemplified in Table 1, it can be easily inferred that blocking the light introduced into indoor areas through glass windows of an architectural structure and the like during the season of hot solar rays will help to create a pleasant indoor environment. In step S630, the control unit 220 may generate a control signal that may start a color change at a solar altitude of 40 degrees or more to reach a visible light transmittance of 15 % or less within 10 minutes, and in step S640, the driving unit 230 may adjust the visible light transmittance by applying capacitance corresponding to the control signal to the electrochromic device 300 according to the control signal.

[0090] Meanwhile, after step S610, the control unit 220 may obtain installation environment information including at least one of fixed azimuth angle and latitude of the electrochromic device 300, and may generate a control signal on the basis of the installation environment information obtained in step S630 (S620, S630).

[0091] The weather data including the azimuth angle (indicating the horizontal angle with respect to true north) for Busan observed in the year of 2000 is shown in Table 2.

[Table 2]

Date		Starting at 280 deg. or more (Time/Azimuth angle)
Spring Equinox	3.20	None (Max. 274 deg.)
Summer solstice	6.21	17 o'clock, 278 deg.
Beginning of hottest period	7.11	17 o'clock, 276 deg.
End of hottest period	8.10	18 o'clock, 278 deg.
Autumnal equinox	9.23	None (Max. 275 deg.)
Winter solstice	12.22	None (Max. 47 deg.)

[0092] With reference to the weather data exemplified in Table 2, it can be inferred that the electrochromic device 300 may be subjected to maintenance of color change and subsequent decoloration during the hot daytime hours of solar rays in summer to maintain indoor pleasantness, and that heating costs may be reduced through sufficient introduction of solar rays into indoor areas in spring, fall, and winter. In step S630, the control unit 220 may generate a control signal so that the color change is maintained at an azimuth angle of 90 to 270 degrees at a solar altitude of 40 degrees or more, and decoloration takes place at a solar altitude of 40 degrees or less or an azimuth angle of 280 degrees or more, and in step S640, the driving unit 230 may apply capacitance corresponding to the control signal to the electrochromic device 300 to adjust the visible light transmittance according to the control signal.

[0093] In addition, the electrochromic device 300 may need to have its color change drive controlled differently depending on the latitude of the installation area. Seoul area is exemplified in Table 3 and Busan area is exemplified in Table 4 as operation state information for each latitude of the installation area.

[Table 3]

Latitude	Operation started to Target reached	Date		Operation started (Time/Elevation angle)	Time to target (Time/Elevation angle)	Free time
37 deg. north latitude	42 to 45 deg.	Beginning of spring	2.3	None (Max. 35 deg.)	None	-
		Spring Equinox	3.20	10:30 (10 to 11 o'clock, 37 to 45 deg.)	11:00	30 min.
		Summer solstice	6.21	9:00 (42 deg.)	9:15 (9 to 10 o'clock, 42 to 54 deg.)	15 min.
		Beginning of hottest period	7.11	9:05 (9 to 10 o'clock, 41 to 52 deg.)	9:20 (9 to 10 o'clock, 41 to 52 deg.)	15 min.
		End of hottest period	8.10	9:30 (9 to 10 o'clock, 37 to 47 deg.)	9:40 (9 to 10 o'clock, 37 to 48 deg.)	10 min.
		Autumnal equinox	9.23	None (Max. 36 deg.)	10:45 (10 to 11 o'clock, 39 to 47 deg.)	25 min.
		Beginning of winter	11.7	None (Max. 28 deg.)	None	-
		Winter solstice	12.22	None (Max. 38 deg.)	None	-

[Table 4]

Latitude	Operation started to Target reached	Date		Operation started (Time/Elevation angle)	Time to target (Time/Elevation angle)	Free time
35 deg. north latitude	40 to 43 deg.	Beginning of spring	2.3	None (Max. 38 deg.)	None	-
		Spring Equinox	3.20	10:00 (40 deg.)	10:20 (10 to 11 o'clock, 40 to 48 deg.)	20 min.
		Summer solstice	6.21	8:40 (8 to 9 o'clock, 31 to 44 deg.)	8:55 (8 to 9 o'clock, 31 to 44 deg.)	15 min.
		Beginning of hottest period	7.11	8:50 (8 to 9 o'clock, 30 to 42 deg.)	9:05 (9 to 10 o'clock, 42 to 54 deg.)	15 min.
		End of hottest period	8.10	9:05 (9 to 10 o'clock, 39 to 51 deg.)	9:20 (9 to 10 o'clock, 39 to 51 deg.)	15 min.
		Autumnal equinox	9.23	9:50 (9 to 10 o'clock, 32 to 42 deg.)	10:05 (10 to 11 o'clock, 42 to 50 deg.)	15 min.
		Beginning of winter	11.7	None (Max. 28 deg.)	None	-
		Winter solstice	12.22	None (Max. 38 deg.)	None	-

[0094] With reference to the operation state information exemplified in Table 3 and FIG. 4, in step S630, the control unit 220 may generate a control signal that starts a color change operation at a solar altitude that is 5 degrees higher than the latitude of an installation area to reach a visible light transmittance of 15% or less before the solar altitude reaches an altitude that is 8 degrees higher than the latitude. In step S640, the driving unit 230 may apply capacitance corresponding to the control signal to the electrochromic device 300 to adjust the visible light transmittance according to the control signal.

[0095] The operation state information for each color change start time and decoloration start time for Seoul area shown in Table 3 is exemplified in Table 5.

[Table 5]

Latitude	Color change started	Decoloration stared	Date		Color change started (Time/Elevation angle)	Decoloration stared (Time/Elevati on angle)
37 deg. north latitude	42 deg. solar altitude	27 deg. solar altitude	Beginning of spring	2.3	None (Max. 38 deg.)	Decoloration maintained
			Spring Equinox	3.20	10:00 (40 deg.)	16:15 (16 to 17 o'clock, 30 to 19 deg.)
			Summer solstice	6.21	8:40 (8 to 9 o'clock, 31 to 44 deg.)	17:25 (17 to 18 o'clock, 32 to 20 deg.)
			Beginning of hottest period	7.11	8:50 (9 to 10 o'clock, 30 to 42 deg.)	17:25 (17 to 18 o'clock, 32 to 20 deg.)
			End of hottest period	8.10	9:05 (9 to 10 o'clock, 39 to 51 deg.)	16:55 (16 to 17 o'clock, 37 to 48 deg.)
			Autumnal equinox	9.23	9:50 (9 to 10 o'clock, 32 to 42 deg.)	16:00 (27 deg.)
			Beginning of winter	11.7	None (Max. 38 deg.)	Decoloration maintained
			Winter solstice	12.22	None (Max. 31 deg.)	Decoloration maintained

[0096] With reference to the operation state information exemplified in Table 5, it is necessary to allow decoloration in conjunction with solar altitude in spring, autumn, and winter in Korea, when it is required to introduce solar rays into indoor areas, and to block the hot solar heat in the middle of the day. In step S630, the control unit 220 may generate a control signal to start a color change operation at a solar altitude that is 5 degrees higher than the latitude of an installation area to allow a decoloration operation to be started at a solar altitude that is 10 degrees lower than the latitude, or to allow decoloration to take place at a solar altitude that is 10 degrees lower than the latitude of the installation area when the outside temperature is 20 degrees or less. In step S640, the driving unit 230 may apply capacitance corresponding to the control signal to the electrochromic device 300 to adjust the visible light transmittance according to the control signal.

[0097] The operation state information exemplified in Table 6 is an example of changes in temperature and solar altitude for Busan area.

[Table 6]

Latitude	Average temperature of color change started	Decoloration stared solar altitude	Date		Average temperature / Maximum temperature	Decoloration stared (Time/Elevati on angle)
North latitude 35 deg.	30 °C	30 deg.	Beginning of spring	2.3	3.1 °C/ 8 °C	No color change, decoloration maintained
			Spring Equinox	3.20	9.6 °C/ 14.3 °C	No color change, decoloration maintained
			Summer solstice	6.21	16.5 °C/ 20.7 °C	Temperature-dependent operation, 17 o'clock (30 deg.)
			Beginning of hottest period	7.11	23.2 °C/ 26.1 °C	Temperature-dependent operation, 17 o'clock (30 deg.)
			End of hottest period	8.10	26.4 °C/ 29.8 °C	Temperature-dependent operation, 16: 40 (16 to 17 o'clock, 39 to 26 deg.)
			Autumnal equinox	9.23	21.2 °C/ 25.3 °C	Temperature-dependent operation, 15: 40 (15 to 16 o'clock, 37 to 27 deg.)
			Beginning of winter	11.7	14.2 °C/ 19.0 °C	Temperature-dependent operation, 14: 10 (14 to 15 o'clock, 31 to 24 deg.)
			Winter solstice	12.22	5.5 °C/ 10.2 °C	No color change, decoloration maintained

[0098] With reference to the operation state information exemplified in Table 6, in step S630, the control unit 220 may generate a control signal to start a decoloration operation when a condition of an outdoor temperature of 15 °C or less and a solar altitude of 30 °C or less is simultaneously satisfied after a color change at an outdoor temperature of 15 °C or more. In step S640, the driving unit 230 may apply capacitance corresponding to the control signal to the electrochromic device 300 to adjust the visible light transmittance according to the control signal.

[0099] The operation state information exemplified in Table 7 is an example of changes in solar altitude, temperature, time, and elevation angle for Busan area.

[Table 7]

Latitude	Color change started Azimut h angle	Decoloration stared Azimuth angle	Date		Average/ Maximum Temperatu re	Color change started (Time/ Azimut h angle)	Decoloration stared (Time/Azimu th angle)
North latitude 35 deg.	100 deg.	280 deg.	Summer solstice	6.21	16.5 °C/ 20.7 °C	10 o'clock/ 100 deg.	17:00 (278 deg.)
			Beginning of hottest period	7.11	23.2 °C/ 26.1 °C	10 o'clock/ 101 deg.	17:30 (17 to 18 o'clock, 276 to 284 deg.)
			End of hottest period	8.10	26.4 °C/ 29.8 °C	9 o'clock/ 98 deg.	18:15 (18 to 19 o'clock, 278 to 287 deg.)

[0100] With reference to the operation state information exemplified in Table 7, in step S630, the control unit 220 may generate a control signal to maintain a color change operation when a condition of an outdoor temperature of 18 °C or more and an azimuth angle of 100 degrees or more and less than 280 degrees are simultaneously satisfied in June to August in the summer season. In step S640, the driving unit 230 may apply capacitance corresponding to the control signal to the electrochromic device 300 to adjust the visible light transmittance according to the control signal.

[0101] Meanwhile, according to the embodiment described above, each step included in the method of driving an electrochromic device performed by the apparatus for driving an electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied may be implemented on a computer-readable recording medium that records a computer program including instructions for performing the steps described above.

[0102] As described above, according to an embodiment of the present disclosure, there is an effect of creating a pleasant indoor environment in accordance with a changing operating environment by controlling the visible light transmittance and chromic rate by changing capacitance applied to an electrochromic device according to solar altitude, azimuth angle, temperature, or the like, which depends on an operating environment of the electrochromic device, so that the transmittance of the electrochromic device is adjusted.

[0103] Combinations of steps in each flowchart attached to the present disclosure may be executed by computer program instructions. Since the computer program instructions can be mounted on a processor of a general-purpose computer, a special purpose computer, or other programmable data processing equipment, the instructions executed by the processor of the computer or other programmable data processing equipment create a means for performing the functions described in each step of the flowchart. The computer program instructions can also be stored on a computer-usable or computer-readable storage medium which can be directed to a computer or other programmable data processing equipment to implement a function in a specific manner. Accordingly, the instructions stored on the computer-usable or computer-readable recording medium can also produce an article of manufacture containing an instruction means which performs the functions described in each step of the flowchart. The computer program instructions can also be mounted on a computer or other programmable data processing equipment. Accordingly, a series of operational steps are performed on a computer or other programmable data processing equipment to create a computer-executable process, and it is also possible for instructions to perform a computer or other programmable data processing equipment to provide steps for performing the functions described in each step of the flowchart.

[0104] In addition, each step may represent a module, a segment, or a portion of codes which contains one or more executable instructions for executing the specified logical function(s). It should also be noted that in some alternative embodiments, the functions mentioned in the steps may occur out of order. For example, two steps illustrated in succession may in fact be performed substantially simultaneously, or the steps may sometimes be performed in a reverse order depending on the corresponding function.

[0105] The above description is merely exemplary description of the technical scope of the present disclosure, and it will be understood by those skilled in the art that various changes and modifications can be made without departing from original characteristics of the present disclosure. Therefore, the embodiments disclosed in the present disclosure are intended to explain, not to limit, the technical scope of the present disclosure, and the technical scope of the present disclosure is not limited by the embodiments. The protection scope of the present disclosure should be interpreted based on the following claims and it should be appreciated that all technical scopes included within a range equivalent thereto are included in the protection scope of the present disclosure.

Claims

1. An apparatus for driving an electrochromic device comprising:

a memory in which an electrochromic device driving program is stored; and
a processor configured to load the electrochromic device driving program from the memory, and to execute the electrochromic device driving program,
wherein the processor is configured to obtain operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of the electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied,
to generate a control signal corresponding to a capacitance to be applied to the electrochromic device on a basis of the operating environment information,
to apply the capacitance corresponding to the control signal to the electrochromic device to drive the electrochromic device so that the transmittance is adjusted, and
to generate the control signal by reflecting climate characteristics obtained by analyzing the operating environment information.

2. The apparatus of claim 1, wherein the processor is configured to generate the control signal so that visible light transmittance of the electrochromic device reaches a preset transmittance or less within a predetermined period of time according to an altitude comparison result of comparing the solar altitude to a preset threshold altitude.

3. The apparatus of claim 2, wherein the processor is configured to generate the control signal further on the basis of installation environment information including at least one of fixed azimuth angle and latitude of the electrochromic device.

4. The apparatus of claim 3, wherein the processor is configured to generate the control signal according to an azimuth angle comparison result of comparing the variable azimuth angle or the fixed azimuth angle to a preset threshold azimuth angles and the altitude comparison result.

5. The apparatus of claim 3, wherein the processor is configured to generate the control signal according to a difference between the latitude of the electrochromic device and the solar altitude.

6. The apparatus of claim 3, wherein the processor is configured to generate the control signal according to a difference between the latitude of the electrochromic device, the solar altitude and the temperature.

7. The apparatus of claim 3, wherein the processor is configured to generate the control signal according to the latitude of the electrochromic device, the altitude comparison result, and the temperature.

8. The apparatus of claim 3, wherein the processor is configured to generate the control signal according to an azimuth angle comparison result of comparing the variable azimuth angle or the fixed azimuth angle to a preset threshold azimuth angle, a position of the electrochromic device, the temperature, and a date and time.

9. A method for driving an electrochromic device, performed by an apparatus for driving an electrochromic device that operates so that transmittance for a specific wavelength is adjusted through color change when electricity is applied, the method comprising:

obtaining operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of the electrochromic device;
determining a capacitance to be applied to the electrochromic device on a basis of the obtained operating environment information; and
applying the determined capacitance to the electrochromic device to drive the electrochromic device so that the transmittance is adjusted,
wherein the determining the capacitance, climate characteristics obtained by analyzing the operating environment information are reflected.

10. The method of claim 9, wherein applying the determined capacitance, the electrochromic device is driven so that visible light transmittance of the electrochromic device reaches a preset transmittance or less within a predetermined period of time according to an altitude comparison result of comparing the solar altitude to a preset threshold altitude.

11. The method of claim 10, wherein the determining the capacitance, the capacitance is determined further on the basis of installation environment information including at least one of fixed azimuth angle and latitude of the electrochromic device.

12. The method of claim 11, wherein the determining the capacitance, the capacitance is determined according to an azimuth angle comparison result of comparing the variable azimuth angle or the fixed azimuth angle to a preset threshold azimuth angles and the altitude comparison result.

13. The method of claim 11, wherein the determining the capacitance, the capacitance is determined according to a difference between the latitude of the electrochromic device and the solar altitude.

14. The method of claim 11, wherein the determining the capacitance, the capacitance is determined according to a difference between the latitude of the electrochromic device, the solar altitude and the temperature.

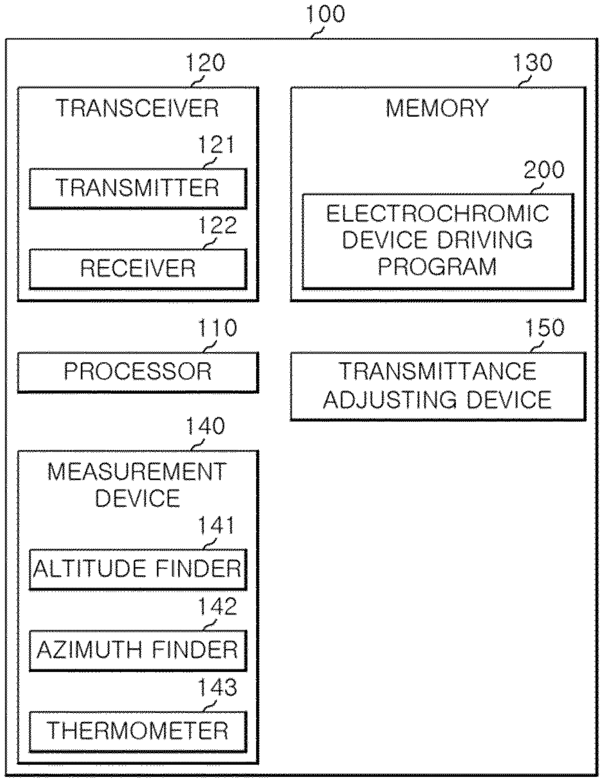
15. The method of claim 11, wherein the determining the capacitance, the capacitance is determined according to the latitude of the electrochromic device, the altitude comparison result, and the temperature.

16. The method of claim 11, wherein the determining the capacitance, the capacitance is determined according to an azimuth angle comparison result of comparing the variable azimuth angle or the fixed azimuth angle to a preset threshold azimuth angle, a position of the electrochromic device, the temperature, and a date and time.

17. A non-transitory computer-readable storage medium storing a computer program, wherein the computer program, when executed by a processor, comprises an instruction for causing the processor to perform a method comprising:

obtaining operating environment information including at least one of solar altitude, variable azimuth angle, and temperature according to an operating environment of an electrochromic device;
determining a capacitance to be applied to the electrochromic device on a basis of the obtained operating environment information; and
applying the determined capacitance to the electrochromic device to drive the electrochromic device so that the transmittance is adjusted, and
wherein the determining the capacitance, climate characteristics obtained by analyzing the operating environment information are reflected.

FIG. 1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TRANSMITTER
122
RECEIVER
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MEMORY
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ELECTROCHROMIC DEVICE DRIVING PROGRAM
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PROCESSOR
150
TRANSMITTANCE ADJUSTING DEVICE
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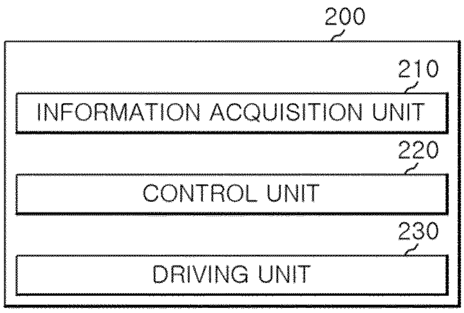
MEASUREMENT DEVICE
141
ALTITUDE FINDER
142
AZIMUTH FINDER
143
THERMOMETER

FIG.2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CONTROL UNIT
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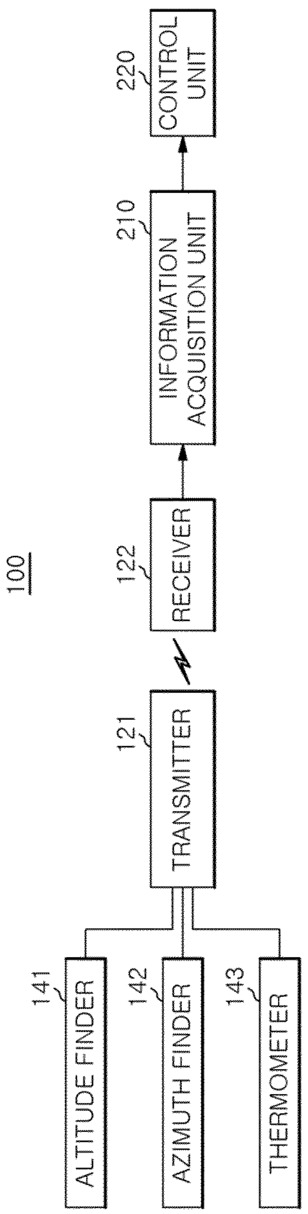
DRIVING UNIT

FIG. 3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AZIMUTH FINDER
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RECEIVER
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220
CONTROL UNIT

FIG.4

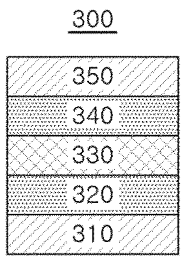
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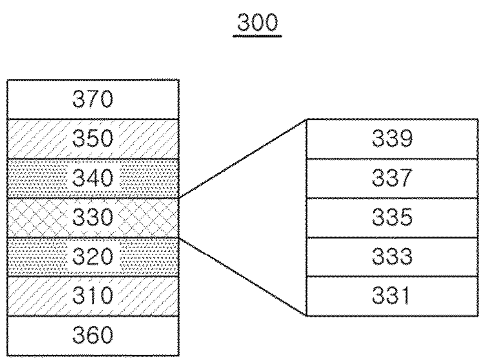
FIG.5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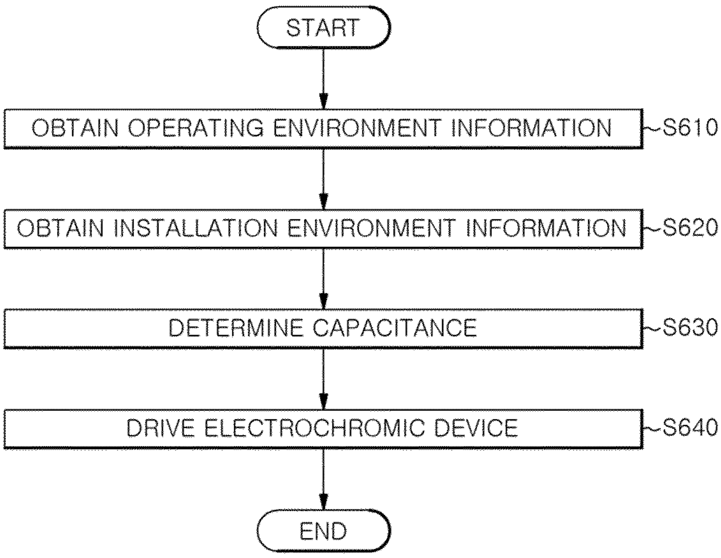
331

FIG.6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S610
OBTAIN INSTALLATION ENVIRONMENT INFORMATION
S620
DETERMINE CAPACITANCE
S630
DRIVE ELECTROCHROMIC DEVICE
S640
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2023/005958

A. CLASSIFICATION OF SUBJECT MATTER

G09G 3/19(2006.01)i; **G02F 1/163**(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G09G 3/19(2006.01); B60J 3/04(2006.01); B60R 16/023(2006.01); E06B 7/12(2006.01); G01S 19/14(2010.01); G02F 1/163(2006.01); H02S 10/00(2014.01); H04W 4/021(2018.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 전기변색소자(electrochromic device), 환경(environment), 방위각(azimuth), 온도(temperature), 고도(altitude)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2021-0122310 A (VIEW, INC.) 08 October 2021 (2021-10-08) See paragraphs [0060], [0063], [0067], [0077], [0091], [0118], [0174] and [0183]; and figures 4-5, 9 and 18.	1-17
A	KR 10-2187022 B1 (LEE, Chun Sik) 04 December 2020 (2020-12-04) See claim 10; and figure 11.	1-17
A	KR 10-2019-0081944 A (YURA CORPORATION CO., LTD.) 09 July 2019 (2019-07-09) See claims 2 and 4; and figure 1.	1-17
A	KR 10-2011-0097697 A (KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY) 31 August 2011 (2011-08-31) See paragraph [0115]; and figure 11.	1-17
A	KR 10-2019-0122789 A (SWITCH MATERIALS INC.) 30 October 2019 (2019-10-30) See claim 1.	1-17

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
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Date of the actual completion of the international search	Date of mailing of the international search report
24 July 2023	**24 July 2023**

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2021-0122310 A	08 October 2021	AU 2013-249621 A1	30 October 2014
		AU 2013-249621 B2	07 September 2017
		AU 2013-249706 B2	20 October 2016
		AU 2014-219076 A1	10 September 2015
		AU 2014-219076 B2	23 November 2017
		AU 2015-227056 A1	08 September 2016
		AU 2015-227056 B2	01 October 2020
		AU 2015-255913 A1	24 November 2016
		AU 2015-255913 B2	08 October 2020
		AU 2015-324000 A1	06 April 2017
		AU 2015-324000 B2	06 May 2021
		AU 2015-353569 A1	25 May 2017
		AU 2015-353569 B2	17 December 2020
		AU 2015-353606 A1	25 May 2017
		AU 2015-353606 B2	21 May 2020
		AU 2015-360714 A1	29 June 2017
		AU 2016-334038 A1	10 May 2018
		AU 2016-346328 A1	17 May 2018
		AU 2016-346328 B2	28 April 2022
		AU 2017-200334 A1	02 February 2017
		AU 2017-257789 A1	22 November 2018
		AU 2017-257789 B2	30 June 2022
		AU 2017-260101 A1	22 November 2018
		AU 2017-260101 B2	22 July 2021
		AU 2017-270472 A1	21 December 2017
		AU 2017-270472 B2	19 December 2019
		AU 2017-363581 A1	20 June 2019
		AU 2017-376447 A1	04 July 2019
		AU 2018-201341 A1	15 March 2018
		AU 2018-201341 B2	05 March 2020
		AU 2018-201341 C1	19 November 2020
		AU 2018-203436 A1	07 June 2018
		AU 2018-260906 A1	29 November 2018
		AU 2019-240134 A1	08 October 2020
		AU 2019-320784 A1	04 March 2021
		AU 2020-202011 A1	09 April 2020
		AU 2020-202011 B2	03 March 2022
		AU 2020-202135 A1	16 April 2020
		AU 2020-202135 B2	28 October 2021
		AU 2020-202135 B9	11 November 2021
		AU 2020-220165 A1	10 September 2020
		AU 2020-220165 B2	27 January 2022
		AU 2020-224620 A1	02 September 2021
		AU 2020-226999 A1	17 September 2020
		AU 2020-250299 A1	05 November 2020
		AU 2020-250299 B2	17 March 2022
		AU 2020-273368 A1	17 December 2020
		AU 2020-273368 B2	08 December 2022
		AU 2020-357759 A1	21 April 2022
		AU 2021-200070 A1	18 March 2021

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		AU 2021-201145 A1	11 March 2021
		AU 2021-201145 B2	14 July 2022
		AU 2021-205049 A1	12 August 2021
		AU 2021-205049 B2	16 February 2023
		AU 2021-215134 A1	02 September 2021
		AU 2021-250838 A1	04 November 2021
		AU 2022-200523 A1	17 February 2022
		AU 2022-202275 A1	21 April 2022
		AU 2022-203439 A1	09 June 2022
		AU 2022-203521 A1	16 June 2022
		AU 2022-203541 A1	16 June 2022
		AU 2022-204730 A1	21 July 2022
		AU 2022-231771 A1	06 October 2022
		AU 2023-201196 A1	06 April 2023
		BR 112022010397 A2	23 August 2022
		CA 170770 S	15 February 2018
		CA 2870627 A1	24 October 2013
		CA 2870627 C	14 December 2021
		CA 2870673 A1	24 October 2013
		CA 2871047 A1	31 October 2013
		CA 2880920 A1	13 February 2014
		CA 2902106 A1	28 August 2014
		CA 2916862 A1	31 December 2014
		CA 2941526 A1	11 September 2015
		CA 2941526 C	28 February 2023
		CA 2948668 A1	12 November 2015
		CA 2963096 A1	07 April 2016
		CA 2968665 A1	02 June 2016
		CA 2968840 A1	02 June 2016
		CA 2970300 A1	16 June 2016
		CA 2980477 A1	29 September 2016
		CA 2991419 A1	12 January 2017
		CA 2991761 A1	12 January 2017
		CA 2998861 A1	23 March 2017
		CA 3000852 A1	13 April 2017
		CA 3001233 A1	13 April 2017
		CA 3003639 A1	04 May 2017
		CA 3017138 A1	14 September 2017
		CA 3022396 A1	02 November 2017
		CA 3023072 A1	09 November 2017
		CA 3034630 A1	01 March 2018
		CA 3038974 A1	05 April 2018
		CA 3039342 A1	12 April 2018
		CA 3039606 A1	12 April 2018
		CA 3044823 A1	31 May 2018
		CA 3045443 A1	07 June 2018
		CA 3047093 A1	21 June 2018
		CA 3047110 A1	21 June 2018
		CA 3062815 A1	01 November 2018
		CA 3062817 A1	01 November 2018

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
		CA	3062818	A1	01 November 2018
		CA	3066285	A1	07 November 2019
		CA	3094479	A1	26 September 2019
		CA	3102449	A1	12 December 2019
		CA	3102958	A1	19 December 2019
		CA	3103480	A1	26 December 2019
		CA	3109581	A1	20 February 2020
		CA	3129952	A1	27 August 2020
		CA	3139813	A1	12 November 2020
		CA	3152920	A1	08 April 2021
		CA	3155214	A1	29 April 2021
		CA	3156883	A1	11 September 2015
		CA	3163059	A1	15 July 2021
		CA	3165657	A1	05 August 2021
		CA	3167832	A1	19 August 2021
		CA	3169817	A1	21 October 2021
		CA	3169820	A1	12 May 2022
		CA	3169821	A1	07 April 2022
		CA	3169929	A1	25 November 2021
		CA	3171879	A1	07 April 2022
		CA	3171898	A1	07 April 2022
		CA	3173667	A1	03 February 2022
		CA	3193219	A1	31 December 2014
		CN	103238107	A	07 August 2013
		CN	103238107	B	07 June 2019
		CN	103261960	A	21 August 2013
		CN	103261960	B	08 August 2017
		CN	103492940	A	01 January 2014
		CN	103492940	B	15 February 2017
		CN	103547965	A	29 January 2014
		CN	103547965	B	08 August 2017
		CN	103649826	A	19 March 2014
		CN	103649826	B	01 May 2018
		CN	104114804	A	22 October 2014
		CN	104246594	A	24 December 2014
		CN	104246594	B	24 September 2019
		CN	104321497	A	28 January 2015
		CN	104321497	B	24 August 2016
		CN	104321696	A	28 January 2015
		CN	104321696	B	18 October 2019
		CN	104335595	A	04 February 2015
		CN	104335595	B	18 September 2018
		CN	104364706	A	18 February 2015
		CN	104364706	B	18 August 2017
		CN	104603686	A	06 May 2015
		CN	104603686	B	08 March 2017
		CN	105143586	A	09 December 2015
		CN	105143586	B	16 November 2018
		CN	105431772	A	23 March 2016
		CN	105431772	B	16 April 2019

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
		CN	106125444	A	16 November 2016
		CN	106125444	B	14 August 2020
		CN	106164973	A	23 November 2016
		CN	106164973	B	01 January 2021
		CN	106462023	A	22 February 2017
		CN	106462023	B	24 December 2019
		CN	106575064	A	19 April 2017
		CN	106575064	B	07 May 2021
		CN	106796380	A	31 May 2017
		CN	106796380	B	03 September 2021
		CN	106837094	A	13 June 2017
		CN	106837094	B	25 June 2021
		CN	106896613	A	27 June 2017
		CN	106896613	B	07 August 2020
		CN	107109892	A	29 August 2017
		CN	107109892	B	12 June 2020
		CN	107110704	A	29 August 2017
		CN	107110704	B	24 December 2021
		CN	107111287	A	29 August 2017
		CN	107111287	B	03 May 2022
		CN	107112620	A	29 August 2017
		CN	107112620	B	31 December 2019
		CN	107209432	A	26 September 2017
		CN	107209432	B	03 September 2021
		CN	107272296	A	20 October 2017
		CN	107340664	A	10 November 2017
		CN	107340664	B	22 January 2021
		CN	107390446	A	24 November 2017
		CN	107390446	B	04 March 2022
		CN	107533267	A	02 January 2018
		CN	107850815	A	27 March 2018
		CN	107850815	B	03 September 2021
		CN	107851413	A	27 March 2018
		CN	107851413	B	26 November 2021
		CN	108139644	A	08 June 2018
		CN	108291424	A	17 July 2018
		CN	108291424	B	12 June 2020
		CN	108351251	A	31 July 2018
		CN	108351251	B	09 July 2021
		CN	108352144	A	31 July 2018
		CN	108352144	B	14 December 2021
		CN	108388058	A	10 August 2018
		CN	108388058	B	21 May 2021
		CN	108922149	A	30 November 2018
		CN	108922149	B	18 June 2021
		CN	109060126	A	21 December 2018
		CN	109060126	B	03 December 2021
		CN	109313498	A	05 February 2019
		CN	109314307	A	05 February 2019
		CN	109314307	B	15 October 2021

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		CN 109653669 A	19 April 2019
		CN 109791338 A	21 May 2019
		CN 109844631 A	04 June 2019
		CN 109844631 B	01 July 2022
		CN 109863425 A	07 June 2019
		CN 109863425 B	01 July 2022
		CN 109923482 A	21 June 2019
		CN 109923482 B	01 November 2022
		CN 110058472 A	26 July 2019
		CN 110058472 B	19 April 2022
		CN 110100072 A	06 August 2019
		CN 110100072 B	16 November 2021
		CN 110114719 A	09 August 2019
		CN 110114719 B	15 November 2022
		CN 110168185 A	23 August 2019
		CN 110187583 A	30 August 2019
		CN 110214293 A	06 September 2019
		CN 110609428 A	24 December 2019
		CN 110609428 B	10 March 2023
		CN 110709765 A	17 January 2020
		CN 110709784 A	17 January 2020
		CN 110716362 A	21 January 2020
		CN 110716362 B	18 November 2022
		CN 110720120 A	21 January 2020
		CN 110832828 A	21 February 2020
		CN 111061110 A	24 April 2020
		CN 111106426 A	05 May 2020
		CN 111106426 B	03 December 2021
		CN 111550172 A	18 August 2020
		CN 111550172 B	23 December 2022
		CN 111550173 A	18 August 2020
		CN 112004984 A	27 November 2020
		CN 112055927 A	08 December 2020
		CN 112236576 A	15 January 2021
		CN 112243522 A	19 January 2021
		CN 112243522 B	01 November 2022
		CN 112262341 A	22 January 2021
		CN 112272787 A	26 January 2021
		CN 112313909 A	02 February 2021
		CN 112313909 B	24 January 2023
		CN 112615135 A	06 April 2021
		CN 112627704 A	09 April 2021
		CN 112731720 A	30 April 2021
		CN 112771241 A	07 May 2021
		CN 113204147 A	03 August 2021
		CN 113219756 A	06 August 2021
		CN 113219757 A	06 August 2021
		CN 113227891 A	06 August 2021
		CN 113267933 A	17 August 2021
		CN 113362585 A	07 September 2021

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
		CN	113574832	A	29 October 2021
		CN	113588075	A	02 November 2021
		CN	113608392	A	05 November 2021
		CN	113655669	A	16 November 2021
		CN	113889744	A	04 January 2022
		CN	113934066	A	14 January 2022
		CN	113940014	A	14 January 2022
		CN	113960844	A	21 January 2022
		CN	114089575	A	25 February 2022
		CN	114114777	A	01 March 2022
		CN	114278210	A	05 April 2022
		CN	114609841	A	10 June 2022
		CN	114667763	A	24 June 2022
		CN	114675460	A	28 June 2022
		CN	114687657	A	01 July 2022
		CN	114729559	A	08 July 2022
		CN	114730117	A	08 July 2022
		CN	114930239	A	19 August 2022
		CN	115087846	A	20 September 2022
		CN	115144933	A	04 October 2022
		CN	115185133	A	14 October 2022
		CN	115315563	A	08 November 2022
		CN	115380507	A	22 November 2022
		CN	115398355	A	25 November 2022
		CN	115398464	A	25 November 2022
		CN	115461676	A	09 December 2022
		CN	115485614	A	16 December 2022
		CN	115632483	A	20 January 2023
		CN	115662040	A	31 January 2023
		CN	115668048	A	31 January 2023
		CN	115694661	A	03 February 2023
		CN	115968454	A	14 April 2023
		CN	115987709	A	18 April 2023
		EP	2517332	A2	31 October 2012
		EP	2517332	A4	31 October 2012
		EP	2517332	B1	26 September 2018
		EP	2638429	A1	18 September 2013
		EP	2638429	A4	10 May 2017
		EP	2638429	B1	24 February 2021
		EP	2649490	A2	16 October 2013
		EP	2649490	A4	02 April 2014
		EP	2649490	B1	11 July 2018
		EP	2686728	A2	22 January 2014
		EP	2686728	A4	20 August 2014
		EP	2686729	A2	22 January 2014
		EP	2686729	A4	10 September 2014
		EP	2686729	B1	08 May 2019
		EP	2686730	A2	22 January 2014
		EP	2686730	A4	27 August 2014
		EP	2686730	B1	06 May 2020

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		EP 2791451 A1	22 October 2014
		EP 2791451 A4	06 May 2015
		EP 2791451 B1	26 September 2018
		EP 2791451 B2	20 July 2022
		EP 2837205 A1	18 February 2015
		EP 2837205 A4	06 January 2016
		EP 2837205 B1	15 February 2017
		EP 2839336 A1	25 February 2015
		EP 2839336 A4	24 February 2016
		EP 2839337 A1	25 February 2015
		EP 2839337 A4	25 November 2015
		EP 2839337 B1	13 December 2017
		EP 2841671 A1	04 March 2015
		EP 2841671 A4	08 June 2016
		EP 2841987 A1	04 March 2015
		EP 2841987 A4	16 March 2016
		EP 2841987 B1	22 January 2020
		EP 2880492 A1	10 June 2015
		EP 2880492 A4	27 April 2016
		EP 2880492 B1	06 October 2021
		EP 2959088 A1	30 December 2015
		EP 2959088 B1	02 January 2019
		EP 3014349 A1	04 May 2016
		EP 3014349 A4	01 March 2017
		EP 3014349 B1	22 August 2018
		EP 3114640 A1	11 January 2017
		EP 3114640 A4	19 July 2017
		EP 3114640 B1	02 November 2022
		EP 3140694 A1	15 March 2017
		EP 3140694 A4	02 May 2018
		EP 3140694 B1	29 July 2020
		EP 3161552 A1	03 May 2017
		EP 3161552 A4	21 March 2018
		EP 3161552 B1	15 January 2020
		EP 3195301 A1	26 July 2017
		EP 3195301 A4	18 July 2018
		EP 3195301 B1	31 March 2021
		EP 3201582 A1	09 August 2017
		EP 3201582 A4	30 May 2018
		EP 3223532 A1	27 September 2017
		EP 3223532 B1	09 October 2019
		EP 3224442 A1	04 October 2017
		EP 3224442 A4	12 December 2018
		EP 3224442 B1	04 January 2023
		EP 3224901 A1	04 October 2017
		EP 3224901 A4	10 October 2018
		EP 3230943 A1	18 October 2017
		EP 3230943 A4	04 July 2018
		EP 3230943 B1	07 July 2021
		EP 3234691 A1	25 October 2017

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		EP 3234691 A4	01 August 2018
		EP 3234691 B1	27 July 2022
		EP 3271782 A1	24 January 2018
		EP 3271782 A4	21 November 2018
		EP 3320391 A1	16 May 2018
		EP 3320391 A4	20 February 2019
		EP 3320391 B1	16 March 2022
		EP 3320534 A1	16 May 2018
		EP 3320534 A4	27 November 2019
		EP 3350651 A1	25 July 2018
		EP 3350651 A4	22 May 2019
		EP 3359930 A1	15 August 2018
		EP 3359930 A4	14 August 2019
		EP 3360125 A1	15 August 2018
		EP 3360125 A4	01 May 2019
		EP 3360125 B1	22 September 2021
		EP 3364241 A1	22 August 2018
		EP 3364241 B1	03 June 2020
		EP 3368736 A1	05 September 2018
		EP 3368736 A4	03 July 2019
		EP 3415984 A1	19 December 2018
		EP 3415984 B1	04 August 2021
		EP 3422095 A1	02 January 2019
		EP 3425450 A1	09 January 2019
		EP 3425450 B1	24 November 2021
		EP 3426874 A1	16 January 2019
		EP 3426874 A4	01 January 2020
		EP 3426874 B1	13 July 2022
		EP 3434853 A1	30 January 2019
		EP 3444664 A1	20 February 2019
		EP 3449341 A1	06 March 2019
		EP 3449341 A4	04 December 2019
		EP 3453072 A1	13 March 2019
		EP 3453072 A4	01 January 2020
		EP 3470611 A1	17 April 2019
		EP 3470611 B1	01 September 2021
		EP 3492973 A1	05 June 2019
		EP 3500891 A1	26 June 2019
		EP 3500891 A4	25 March 2020
		EP 3519889 A1	07 August 2019
		EP 3519889 A4	29 April 2020
		EP 3520067 A1	07 August 2019
		EP 3520067 A4	04 November 2020
		EP 3522456 A1	07 August 2019
		EP 3522456 B1	05 May 2021
		EP 3523614 A1	14 August 2019
		EP 3523614 A4	10 June 2020
		EP 3545159 A1	02 October 2019
		EP 3545159 A4	17 June 2020
		EP 3548965 A1	09 October 2019

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		EP 3548965 A4	05 August 2020
		EP 3548965 B1	04 January 2023
		EP 3555701 A2	23 October 2019
		EP 3555701 A4	27 May 2020
		EP 3568562 A1	20 November 2019
		EP 3568562 A4	02 December 2020
		EP 3587723 A1	01 January 2020
		EP 3594743 A1	15 January 2020
		EP 3611707 A1	19 February 2020
		EP 3616000 A1	04 March 2020
		EP 3616000 A4	16 December 2020
		EP 3616008 A1	04 March 2020
		EP 3616008 A4	09 December 2020
		EP 3616189 A2	04 March 2020
		EP 3616189 A4	09 December 2020
		EP 3705937 A1	09 September 2020
		EP 3705937 B1	15 March 2023
		EP 3751089 A1	16 December 2020
		EP 3766162 A1	20 January 2021
		EP 3768934 A1	27 January 2021
		EP 3768935 A1	27 January 2021
		EP 3781971 A1	24 February 2021
		EP 3781971 A4	12 January 2022
		EP 3788769 A1	10 March 2021
		EP 3803506 A2	14 April 2021
		EP 3803815 A1	14 April 2021
		EP 3811574 A1	28 April 2021
		EP 3837414 A1	23 June 2021
		EP 3848924 A1	14 July 2021
		EP 3859444 A1	04 August 2021
		EP 3869265 A2	25 August 2021
		EP 3869265 A3	10 November 2021
		EP 3876030 A1	08 September 2021
		EP 3887902 A1	06 October 2021
		EP 3926572 A1	22 December 2021
		EP 3926572 A4	22 December 2021
		EP 3928477 A1	29 December 2021
		EP 3929394 A1	29 December 2021
		EP 3929394 A4	29 December 2021
		EP 3929395 A1	29 December 2021
		EP 3929395 A4	29 December 2021
		EP 3933498 A1	05 January 2022
		EP 3933498 A4	05 January 2022
		EP 3944013 A1	26 January 2022
		EP 3966963 A2	16 March 2022
		EP 3995885 A1	11 May 2022
		EP 4038449 A1	10 August 2022
		EP 4038929 A1	10 August 2022
		EP 4040230 A2	10 August 2022
		EP 4040230 A3	17 August 2022

Form PCT/ISA/210 (patent family annex) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/005958

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		EP 4048851 A1	31 August 2022
		EP 4070583 A1	12 October 2022
		EP 4086697 A1	09 November 2022
		EP 4089262 A1	16 November 2022
		EP 4097425 A1	07 December 2022
		EP 4103809 A1	21 December 2022
		EP 4104016 A1	21 December 2022
		EP 4118497 A1	18 January 2023
		EP 4120012 A1	18 January 2023
		EP 4127829 A1	08 February 2023
		EP 4128130 A1	08 February 2023
		EP 4136504 A1	22 February 2023
		EP 4145379 A1	08 March 2023
		EP 4147091 A1	15 March 2023
		EP 4154060 A1	29 March 2023
		EP 4170123 A1	26 April 2023
		ES 2718671 T3	03 July 2019
KR 10-2187022 B1	04 December 2020	None	
KR 10-2019-0081944 A	09 July 2019	KR 10-2127158 B1	26 June 2020
KR 10-2011-0097697 A	31 August 2011	KR 10-1199504 B1	14 November 2012
KR 10-2019-0122789 A	30 October 2019	CN 110573939 A	13 December 2019
		EP 3590005 A1	08 January 2020
		JP 2020-510572 A	09 April 2020
		JP 7295801 B2	21 June 2023
		US 2020-0207187 A1	02 July 2020
		WO 2018-157241 A1	07 September 2018

Form PCT/ISA/210 (patent family annex) (July 2022)